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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Nuclear power plants – Control rooms – Requirements for emergency response facilities

Centrales nucléaires de puissance – Salles de commande – Exigences pour les moyens de réaction d'urgence

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NUCLEAR POWER PLANTS – CONTROL ROOMS – REQUIREMENTS FOR EMERGENCY RESPONSE FACILITIES

FOREWORD

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The text of this International Standard is based on the following documents:

FDIS	Report on voting
45A/1236/FDIS	45A/1251/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

a) Technical background, main issues and organisation of the Standard

The Fukushima-Daiichi accident has shown that extremely severe hazards can occur for which a nuclear power plant has not been designed to resist. In such situations, the plant has possibly to cope with one or several damaged reactors, and associated radioactive releases, but also has to cope with the loss of a major part of the electrical sources, cooling functions and I&C, possibly including the Main Control Room (MCR), as well as with difficulties in accessing the site. Providing safe on-site facilities for managing such an emergency is hence a major issue.

An international consensus has emerged to promote the design and installation of a specific set of facilities aiming at coordinating the efforts of personnel charged with controlling the emergency activities and those of authorities external to the site charged with protecting the population and the environment. These facilities are called the Emergency Response Facilities (ERF).

Different countries, utilities and nuclear power plants have different geographical and infrastructure characteristics and different requirements under emergency situations. However, the same fundamentals apply in terms of both on-site and off-site requirements.

The IAEA requirements for emergency response are addressed in SSR-2/1 and GSR Part 7. Informative Annex A provides the more relevant extracts from these two IAEA publications.

Figure 1 below illustrates the most important control locations, emergency response facilities and other associated facilities on-site and off-site. Some of the on-site facilities could be combined to support close-communication or their functions could be dispersed across other on-site facilities. The level of hardening and autonomy of the individual on-site facilities could vary considerably.

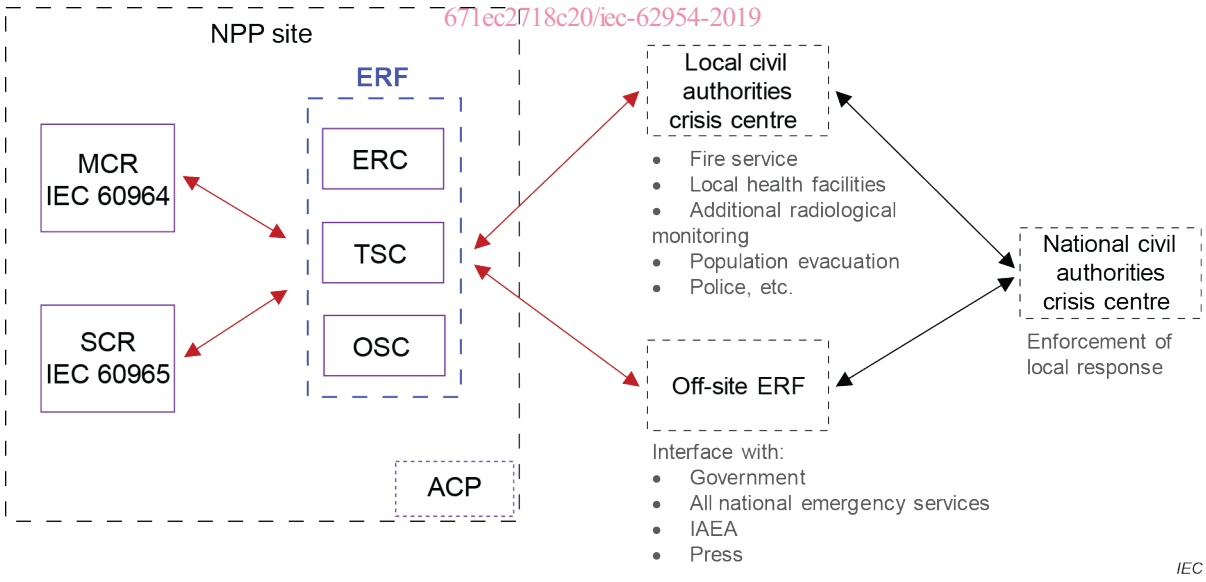

Figure 1 – On-site and off-site ERFs and communicating entities

NOTE 1 No internationally standardized terminology has been established for the various on-site and off-site emergency response facilities. The terms used in Figure 1 indicate the ones that have been adopted in this document.

NOTE 2 Depending on local contexts, the “on-site” ERFs could be implemented close to the NPP and not inside it.

NOTE 3 The role and composition of the off-site civil authorities and emergency infrastructure are known to vary widely. These entries in Figure 1 are therefore considered as illustrative only.

As indicated in Figure 1 some functional services are already dealt with in IEC standards.

This standard was proposed after the Fukushima-Daiichi accident to take into account the lessons learned from those dramatic events. Several reports prepared after the accident, at national level (Japanese Government report) as well as at international level (IAEA fact finding mission) highlighted the role played by the Emergency Response Centre (ERC) during those events and identified the need to take into account the experience gained to strengthen the requirements for such a facility.

This led to the development of this standard, with the following principles:

- The scope should align with that of the relevant IAEA guidance, as given in SSR-2/1, Rev. 1 and GSR Part 7;
- The scope should address the three functional facilities related to Emergency Response that are addressed by the IAEA guidance (i.e. the ERC, TSC and OSC);
- The scope should be limited to such facilities that are on or near the NPP site. The scope should exclude activities in the scope of local response authorities;
- The requirements should be defined in terms of the functions that are to be performed;
- The standard should address the way in which the functions are invoked in response to different severities of incident / accident and any responsibilities that would be transferred from the MCR to the Emergency Response Facilities (ERFs);
- The scope should include consideration of the requirements for environment control, lighting, power supplies, access control of the ERFs, etc., as needed to enable the Emergency Response functions to be performed;
- The only “controls” that should be provided are those that relate to the services that provide the above mentioned environment control, lighting, power supplies, access control of the ERFs, etc.;
- The standard should recognize that a wide range of national or regional situations exist regarding the structure and arrangements for the off-site Emergency Response support.

This IEC standard specifically focuses on the issue of requirements relevant for the Emergency Response Facilities (ERFs).

It is intended that the Standard be used by designers and operators of NPPs (utilities), systems evaluators, vendors and subcontractors, and by licensors.

b) Situation of the current Standard in the structure of the IEC SC 45A standard series

IEC 62954 is at the third level of the IEC SC 45A standard series. It is to be considered as affiliated to IEC 60964, the top document on control rooms in the SC 45A standard series.

For a generic description of the structure of the IEC SC 45A standard series, see item d) of this introduction.

c) Recommendations and limitations regarding the application of the Standard

This standard establishes functional requirements for Emergency Response Facilities and clarifies the design and operation of the ERF systems to be used in case of incidents or accidents occurring on nuclear power plants (NPPs) and/or nuclear facilities.

It is recognized that this is an evolving area of regulatory requirements, due to ongoing analysis of the Fukushima lessons learned. Therefore, the goal of this project is to provide a standard, which defines the framework within which the evolving country or plant specific requirements may be developed and applied.

d) Description of the structure of the IEC SC 45A standard series and relationships with other IEC documents and other bodies documents (IAEA, ISO)

The top-level documents of the IEC SC 45A standard series are IEC 61513 and IEC 63046. IEC 61513 provides general requirements for I&C systems and equipment that are used to perform functions important to safety in NPPs. IEC 63046 provides general requirements for electrical power systems of NPPs; it covers power supply systems including the supply systems of the I&C systems. IEC 61513 and IEC 63046 are to be considered in conjunction and at the same level. IEC 61513 and IEC 63046 structure the IEC SC 45A standard series and shape a complete framework establishing general requirements for instrumentation, control and electrical systems for nuclear power plants.

IEC 61513 and IEC 63046 refer directly to other IEC SC 45A standards for general topics related to categorization of functions and classification of systems, qualification, separation, defence against common cause failure, control room design, electromagnetic compatibility, cybersecurity, software and hardware aspects for programmable digital systems, coordination of safety and security requirements and management of ageing. The standards referenced directly at this second level should be considered together with IEC 61513 and IEC 63046 as a consistent document set.

At a third level, IEC SC 45A standards not directly referenced by IEC 61513 or by IEC 63046 are standards related to specific equipment, technical methods, or specific activities. Usually these documents, which make reference to second-level documents for general topics, can be used on their own.

A fourth level extending the IEC SC 45 standard series, corresponds to the Technical Reports which are not normative.

The IEC SC 45A standards series consistently implements and details the safety and security principles and basic aspects provided in the relevant IAEA safety standards and in the relevant documents of the IAEA nuclear security series (NSS). In particular this includes the IAEA requirements SSR-2/1, establishing safety requirements related to the design of nuclear power plants (NPPs), the IAEA safety guide SSG-30 dealing with the safety classification of structures, systems and components in NPPs, the IAEA safety guide SSG-39 dealing with the design of instrumentation and control systems for NPPs, the IAEA safety guide SSG-34 dealing with the design of electrical power systems for NPPs and the implementing guide NSS17 for computer security at nuclear facilities. The safety and security terminology and definitions used by SC 45A standards are consistent with those used by the IAEA.

IEC 61513 and IEC 63046 have adopted a presentation format similar to the basic safety publication IEC 61508 with an overall life-cycle framework and a system life-cycle framework. Regarding nuclear safety, IEC 61513 and IEC 63046 provide the interpretation of the general requirements of IEC 61508-1, IEC 61508-2 and IEC 61508-4, for the nuclear application sector. In this framework IEC 60880, IEC 62138 and IEC 62566 correspond to IEC 61508-3 for the nuclear application sector. IEC 61513 and IEC 63046 refer to ISO as well as to IAEA GSR Part 2 and IAEA GS-G-3.1 and IAEA GS-G-3.5 for topics related to quality assurance (QA). At level 2, regarding nuclear security, IEC 62645 is the entry document for the IEC/SC 45A security standards. It builds upon the valid high level principles and main concepts of the generic security standards, in particular ISO/IEC 27001 and ISO/IEC 27002; it adapts them and completes them to fit the nuclear context and coordinates with the IEC 62443 series. At level 2, IEC 60964 is the entry document for the IEC/SC 45A control rooms standards and IEC 62342 is the entry document for the ageing management standards.

NOTE 1 It is assumed that for the design of I&C systems in NPPs that implement conventional safety functions (e.g. to address worker safety, asset protection, chemical hazards, process energy hazards) international or national standards would be applied.

NOTE 2 IEC/SC 45A domain was extended in 2013 to cover electrical systems. In 2014 and 2015 discussions were held in IEC/SC 45A to decide how and where general requirements for the design of electrical systems were to be considered. IEC/SC 45A experts recommended that an independent standard be developed at the same level as IEC 61513 to establish general requirements for electrical systems. Project IEC 63046 is now launched to cover this objective. When IEC 63046 is published this NOTE 2 of the introduction of IEC/SC 45A standards will be suppressed.

NUCLEAR POWER PLANTS – CONTROL ROOMS – REQUIREMENTS FOR EMERGENCY RESPONSE FACILITIES

1 Scope

This document presents the requirements for the on-site emergency response facilities (referred to hereinafter as the “ERF”) which are to be used in case of incidents or accidents occurring on the associated Nuclear Power Plant (NPP). The ERF consists of the Emergency Response Centre (ERC), the Technical Support Centre (TSC) and the Operational Support Centre (OSC), as shown in Figure 1.

It establishes requirements for the ERF features and ERF I&C equipment to:

- coordinate on-site operational efforts with respect to safety and radioprotection;
- optimize the design in terms of environment control, lighting, power supplies and access control of the ERF;
- enhance the identification and resolution of potential conflicts between the traditional operational means and emergency means (MCR/SCR and ERF, operating staff and emergency teams, operational procedures and emergency procedures);
- aid the identification and the enhancement of the potential synergies between the traditional operational means and emergency means.

This document is intended for application to new nuclear power plants whose conceptual design is initiated after the publication of this document, but it may also be used for designing and implementing ERF in existing nuclear power plants or in any other nuclear facility.

Detailed equipment design is outside the scope of this document.

This document does not define the situations (reactor plant conditions, hazards and magnitudes of hazards) leading to mobilisation of emergency response teams and activation / use of the ERF. These aspects are usually addressed in the NPP Emergency Plan. However, the need for consistency of the ERF design and operation with the NPP Emergency Plan is within scope.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC/IEEE 60780-323, *Nuclear facilities – Electrical equipment important to safety – Qualification*

IEC 61226:2009, *Nuclear power plants – Instrumentation and control important to safety – Classification of instrumentation and control functions*

IEC 61513, *Nuclear power plants – Instrumentation and control important to safety – General requirements for systems*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
Access Control Point
ACP
area (one or more) within the facility security boundary to control the entry and exit of off-site personnel, in particular emergency teams

3.2
assembly point
location (one or more) where non-essential personnel at the facility are assembled, accounted for and sheltered or evacuated

3.3
emergency
non-routine situation or event that necessitates prompt action, primarily to mitigate a hazard or adverse consequences for human life, health, property or the environment

Note 1 to entry: This includes nuclear and radiological emergencies and conventional emergencies such as fires, release of hazardous chemicals, storms or earthquakes.

Note 2 to entry: This includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard.

[SOURCE: IAEA GSR Part 7, 2015]

3.4
emergency plan
description of the objectives, policy and concept of operations for the response to an emergency and of the structure, authorities and responsibilities for a systematic, coordinated and effective response

Note 1 to entry: The emergency plan serves as the basis for the development of other plans, procedures and checklists.

[SOURCE: IAEA GSR Part 7, 2015]

3.5
emergency response
performance of actions to mitigate the consequences of an emergency for human life, health, property and the environment

[SOURCE: IAEA GSR Part 7, 2015]

3.6
Emergency Response Centre
ERC
area set aside on or near to the NPP site for staff to manage the overall response to the emergency and to handle the off-site interfaces

3.7
Emergency Response Facility
ERF
facility or location needed for supporting an emergency response, for which specific functions are to be assigned at the preparedness stage, and which need to be usable under emergency conditions

[SOURCE: IAEA GSR Part 7, 2015]

3.8
function
specific purpose or objective to be accomplished, that can be specified or described without reference to the physical means of achieving it

3.9
functional analysis
examination of the functional goals of a system with respect to available manpower, technology, and other resources, to provide the basis for determining how the function may be assigned and executed

[SOURCE: IEC 60964:2018, 3.12]

3.10
functional goal
performance objectives that shall be satisfied to achieve the corresponding function

[SOURCE: IEC 60964: 2018, 3.13]

3.11
Nuclear Power Plant site
NPP site
geographical area that contains the NPP, circumscribed by the security perimeter fence or other designated property marker

[SOURCE: IAEA GSR Part 7, 2015]

3.12
Operational Support Centre
OSC
area separate from the main control room where NPP operations support staff will assemble in an emergency situation to be assigned to various duties (e.g. environmental monitoring, health physics, damage control and fire fighting)

3.13
task analysis
identification and description of an operator's task, in terms of its components, to specify the detailed human activities involved, and their functional and temporal relationships

Note 1 to entry: Frequently, task analysis in understood to also include the evaluation of the operator's tasks. In the frame of IEC 60964, this evaluation is described in terms of verification and validation of function assignment and verification and validation of the integrated control room system (which also covers the operator tasks).

[SOURCE: IEC 60964: 2018, 3.31]

3.14
tasks
actions performed by humans for the accomplishment of a functional goal

[SOURCE: IEC 60964: 2018, 3.32]

3.15
Technical Support Centre
TSC
area separate from the main control room where NPP operations support staff can assemble in the event of a reactor incident or accident to provide technical support to the control room operators

4 Symbols and abbreviated terms

ACP	Access Control Point
ERC	Emergency Response Centre
ERF	Emergency Response Facility (or Facilities)
HFE	Human Factors Engineering
HMI	Human Machine Interface
I&C	Instrumentation and Control
MCR	Main Control Room
NPP	Nuclear Power Plant
OSC	Operational Support Centre
SCR	Supplementary Control Room
TSC	Technical Support Centre

5 ERF basis for design

5.1 General

An overarching principle of this document is that the emergency plan for the nuclear power plant site (assumed to comprise one or more reactor units and associated spent fuel storage facilities) imposes overall requirements for the ERF which are further detailed in this document. This includes criteria for the time of activation of the ERF and the responsibilities that are to be transferred from other NPP locations to the ERF.

In some cases the specification and the design of the ERF and the ERF I&C systems will be done many years after the specification and design of the NPP to which the ERF relates. There will be technical interaction through interfaces between ERF individual systems and the NPP existing I&C systems, so that consistent provisions for the exchange of data and interoperability of the ERF with the NPP are established.

The ERF buildings and equipment that are difficult to be replaced should be designed with the same life duration as the NPP to which they relate. This duration may include some of the decommissioning period if this is necessary for the plant safety.

5.2 Role and main features

5.2.1 General

The role of the ERF is to provide adequate means, including organization and human expertise, when a plant has experienced a reactor incident, accident or other emergency situation, including a severe reactor accident or severe external hazard, in order:

- to manage the situation and mitigate its consequences;
- to bring relief and assistance to the operating staff on duty;
- to inform official authorities.

The ERF shall be able to cope simultaneously with all units of the NPP in which it is implemented.

As it is impossible to specify all scenarios for which ERF operation may be required, it is necessary to incorporate flexibility and intelligence into the design and operational arrangements in order to maximise the potential for adapting to the actual situation.

Each facility listed below (i.e. ERC, TSC and OSC) may be a building, part of a building or a room.

The organizational relationship between the parts of ERF shall be defined early in the design. This definition shall comprise clarification of:

- leadership and hierarchy between the parts;
- scope and role of internal and external communication;
- principles for sharing of responsibilities between the three parts and the MCR / SCR.

5.2.2 Emergency Response Centre (ERC)

The ERC is a facility, separate from the MCR, which leads and manages the overall emergency response. This includes coordination with the OSC for the field operations (see 5.2.4) and with the TSC for the technical advice to the operators (see 5.2.3). It also includes managing the flow of information to and from external bodies, including requests for external assistance and any necessary briefings to relevant off-site organizations.

The ERC should have the following operational features:

- a layout that promotes a “command and control” organisational structure, with facilities for regular briefing sessions, etc., and separate areas for teams performing independent tasks;
- secure and reliable communications with other parts of the ERF, with the MCR (or SCR, as applicable), with off-site authorities and with other parts of the off-site emergency response organisation;
- a monitoring capability similar to that available in the MCR, including monitoring of radiation levels throughout the NPP and in the immediate locality of the site, and including parameters assigned to severe accidents; the monitored elements should be defined based on a task analysis;
- access to the emergency plans, NPP design information, operating procedures, etc.;
- suitable space / working surfaces for reading documents, writing, etc.

5.2.3 Technical Support Centre (TSC)

The TSC is a facility separate from the MCR from where NPP operations support staff can provide technical support to the control room operators in the event of a reactor incident or accident.

The TSC should have the following operational features:

- secure and reliable communications with other parts of the ERF, with the MCR (or SCR, as applicable) and with off-site technical support organisations (e.g. NPP designer);